Achilles insertional tendinopathy: state of the art

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ABSTRACT

Achilles tendon pathology is a most common musculoskeletal condition in active individuals and athletes. Almost 6% of the general population will suffer from such ailment in their lifetime. Insertional Achilles tendinopathy (IAT) differs in its physiopathology, clinical features and treatment from midportion tendinopathy. The literature has mainly focused on assessment, outcome evaluation and treatment of IAT, although differences in management according to different geographical regions have not been addressed. The principles of clinical evaluation and imaging assessment of IAT are well established, with a major role of clinical assessment and soft tissue imaging, including ultrasonography and MRI. Conservative management options include eccentric training, extracorporeal shockwave therapy and prolotherapy, or a combination of these modalities. Recently, regenerative medicine has been more widely used, with at times dubious results. Surgery is advocated where conservative treatment is not beneficial within 6 months. Surgery includes more or less extensive debridement of peritendinous bony and soft tissue structures. To improve our knowledge about IAT, more evidence should be provided concerning innovative treatments, especially considering growth factors injections and percutaneous surgery.

INTRODUCTION

Achilles tendon pathology is a common musculoskeletal condition in active individuals and athletes. Although the incidence of Achilles tendon problems is not well established,[1] almost 6% of the general population will suffer from such ailment in their lifetime.[2 3] According to the definition by Clain and Baxter,[4] and subsequently expanded by van Dijk *et al*,[5] tendon ailments can be divided on the basis of the affected region of the tendon. Thus, a distinction must be made between midportion and insertional tendinopathy.[4] The latter is less common, accounting for 20%–25% of Achilles tendinopathies, although midportion tendinopathy represents 55%–60% and only a minor role is attributed to proximal tendinopathy (9%–20%).[2] Furthermore, insertional Achilles tendinopathy (IAT) can occur alone or in combination with midportion tendinopathy. A different epidemiology has been established for IAT, since it is more likely to affect older people and retired athletes or less athletic, overweight people. IAT involves the enthesis, the interface between tendon and bone, and represents a relevant anatomical and functional structure for the viability and biomechanics of the tendon. In fact, tendon vascularisation arises in this region, which is involved in physiological and pathological responses of the tendon to injury.

The suffixes used to describe tendon conditions are extremely precise and reflect a specific condition of the tendon tissue. The term 'tendinopathy' refers to the clinical condition of pain, swelling and impaired function of the tendon. Differently, the terms 'tendinitis' and 'tendinosis' refer to histopathological conditions; the suffix '-itis' is given for a condition of inflammation of the tissue, while the suffix '-osis' is attributed to a degenerated tissue, typical of chronic conditions.[1]

From an overall perspective, the insertion of the Achilles tendon to calcaneus is surrounded by other structures that can become inflamed and injured, mimicking IAT. Retrocalcaneal bursitis results in pain and skin reddening over the calcaneus, signs commonly found in insertional tendinopathy as well. Bony conditions include Haglund's deformity and retrocalcaneal exostosis. The former is a true calcaneal prominence of the posterior or posterolateral aspect of the calcaneus, while the latter is an intratendinous exostosis, often associated with chronic pathological stimuli and insertional tendinopathy. Therefore, the first step for the appropriate management of IAT is to consider several differential diagnoses and to exclude conditions other than tendinopathy. In addition, as several treatments have been proposed for the treatment of IAT, either conservative or surgical, an accurate clinical and imaging evaluation is mandatory to define the best treatment choice on an individual basis. Non-surgical treatment is usually advocated as a first-line treatment, while surgery is reserved for those patients who do not improve after one or more attempts of conservative management.

The present article aims to collect and analyse the latest evidence and summarise the state of the art concerning IAT, especially focusing on diagnostic procedures and tools, and conservative and surgical treatments.

ESSENTIAL FEATURES OF IAT

IAT is common in adults, especially in athletes, or those who undertake new physical activities without specific training (eg, tennis playing and running). However, IAT also affects people with lower extremities deformity, leg length discrepancies and limited mobility of the subtalar joint. Classically, insertional Achilles tendinopathy has been associated with a varied interaction of intrinsic and extrinsic risk factors. Among intrinsic factors, age, chronic comorbidities, limb alignment defects play a major role; unaccustomed activities are the main extrinsic risk factor. The most common symptoms of IAT are pain and swelling of the posterior aspect of the heel, with impaired function and stiffness. Moreover, patients often describe worsening of symptoms at night or during rest and with restart of activity. Tenderness is usually present at palpation

Box 1 Key articles

- Krishna Sayana M, Maffulli N. Insertional Achilles tendinopathy. *Foot Ankle Clin*. 2005.
- Carmont MR, Maffulli N. Management of insertional Achilles tendinopathy through a Cincinnati incision. *BMC Musculoskelet Disord*. 2007.
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of the distal part of the tendon, approximately over its distal 2 cm. Redness and swelling can be noted on the skin overlying this area, associated to nodularity of the tendon at its insertion. When retrocalcaneal bursitis is associated to tendinopathy,

Box 2 Validated outcome measures and classifications

- In most of the recent peer-reviewed studies, validated questionnaires are administered to the patients to assess outcomes of treatment. Apart from general evaluation of pain through the visual analogue scale (VAS)[19 20] and quality of daily living through the Short Form questionnaire (SF-36),[21] assessment of foot and ankle pathology is often performed using the score of the American Orthopaedic Foot and Ankle Society (AOFAS)[20–25] hind foot subscale.[25 26] Actually, the AOFAS questionnaire has not been validated, and some authors raised concerns about its association to the SF-36.[27 28] Nevertheless, the AOFAS score is widely used for the evaluation of hindfoot pathology. This questionnaire is focused on the symptoms, function and walking ability, and range of motion of the ankle. However, this score is not specific to the Achilles tendon. The most specific and thoroughly validated score to assess Achilles tendon pathology is the Victorian Institute of Sport Assessment for Achilles (VISA-A). This has been used in most of the level I studies published over the last 15 years.[19 23 25 29–31] This score specifically focuses on symptoms and function of the Achilles tendon, investigating the influence that these features may have on gait and normal habits. A recent protocol for a Cochrane Collaboration systematic review[32] reported that the VISA-A score is the main validated score to assess Achilles tendon outcomes following injective treatments.

Box 3 Key issues of patient selection

- Outcomes of surgery are not homogeneous in the published studies, often from bias in patient selection. As some relevant preoperative factors are associated with a poor outcome after surgery,[69] including visual analogue scale, limited ankle range of motion, previous corticosteroid injections and the presence of enthesophytes, the presence or not of these factors in the patients enrolled could significantly affect the results of the whole cohort.

palpation of the medial and lateral aspect of the insertion of the Achilles tendon elicits tenderness. The presence of this finding helps to define treatment, since inflammation of the bursa may require specific anti-inflammatory management. Worsening of pain is usually related to training, climbing stairs and running, especially when runners impact the ground with their heel first. In addition, hill running can be causative and aggravating of IAT, as can aggressive stretching. Therefore, a recent history of increased training may be present in many patients.[1] Also, increased stiffness is usually reported after prolonged periods of rest and in the morning on rising,[2] and limited dorsiflexion of the ankle may occur. Therefore, a Silverskold test should be performed to rule out isolated gastrocnemius contracture.[2] Moreover, decreased strength in plantarflexion of the foot may be present, and weakness of the long flexor muscles must be excluded. Plain radiography assesses the presence of calcifications of the tendon (figure 1A). Calcific tendinopathy can be classified into three types: in type I, calcifications are distal, at the superior pole of the calcaneus; in type II, one or more intratendinous calcifications are present 1–3 cm proximally to the insertion; and in type III, the calcification is even more proximal, within 12 cm above the insertion.[6] Furthermore, type III calcification may be partial (IIIa) or complete (IIIb). However, when radiography is not diagnostic and clinical suspicion persists, ultrasonography (US) or MRI should be considered.[2] Given the superficial location of the tendon, US evaluation provides an accurate view of

Box 4 Essential features of insertional Achilles tendinopathy

- High prevalence in athletes and untrained active adults.
- Main risk factors include: age, chronic comorbidities, limb alignment defects, unaccustomed activities and inappropriate shoe wear.
- Most common symptoms include pain and swelling of the posterior aspect of the heel, impaired function and stiffness, with worsening at night or during rest and at restart of activity.
- At examination, common findings are: tenderness at the distal part of the tendon, associated to nodularity of the tendon insertion, redness and swelling.
- When retrocalcaneal bursitis is associated to tendinopathy, palpation of the medial and lateral aspect of the insertion elicits tenderness.
- Initial imaging evaluation is carried out through ultrasound of the tendon and calcaneus with or without plain radiographs of the ankle and hindfoot when calcification is suspected.
- Initial management is conservative, and only after 3–6 months of unsuccessful treatment should surgical options be considered.

Box 5 Tips and tricks

- The lateral approach has been advocated if detachment of the insertion for tendon debridement or osteotomy of the superior posterolateral corner of the calcaneus is planned, since the lateral portion of the insertion of the Achilles tendon extends anteriorly less extensively, compared with the medial portion. Therefore, elevating and detaching the lateral insertion should minimise the risk of postoperative avulsion.[52] If needed, up to 50% of the insertion can safely be detached from the calcaneus.[53] Furthermore, superior-to-inferior resection is recommended.[53] Calcific tendinopathy can be appropriately managed through extracorporeal shockwave therapy (ESWT) initially, with progression to surgery only after the failure of ESWT. Surgical management consists in complete detachment of the insertion, accurate debridement and removal of the calcification and suture anchor reattachment. Studies carried out by the senior author reported that this technique is efficient and safe, leading to no postoperative detachment or tear.[54] In calcific insertional tendinopathy, Miao *et al*[70] advocate a midline longitudinal approach, as the calcific deposits lie in that area in 95% of cases. However, a Cincinnati approach allows to locate the calcification wherever it may lie, without the problems discussed above of the midline longitudinal incision. Return to athletic competition is not recommended before 9 months after surgery.[71] However, the choice to return to training and competition should be taken in agreement with the athlete to avoid compliance issues.

parallel fibrillar structure of the tissue, which can be altered in tendinopathy (figure 1B,C).[7] In addition, the use of US allows the evaluation of several features, such as cross-sectional area of the tendon, size and location of calcific plaques.[8] Power Doppler can help in visualising the vascularisation within the tendon.[9] Furthermore, retrocalcaneal bursitis is easily visualised and diagnosed using US, as fluid distention of the bursa is seen at the tendon–calcaneal interface, behind the posterior angle of the calcaneus.[9] MRI helps to exclude pathologies of the surrounding soft tissues, including bursae. Although MRI images are often interpreted as depicting the presence of partial or full-thickness tendon tears, such 'tears' are at best uncommon[10] and are very rarely encountered at surgery. The inability of the tendon to heal ('failed healing response') can be also assessed, observing increased intensity on T2-weighted sequences and decreased intensity in T1-weighted sequences (figure 2).[11] Similar to US assessment, the visualisation of the bursa at MRI helps to evaluate possible associated bursitis. However, the presence of imaging abnormalities is not always associated to clinical signs of IAT, and vice versa.[12 13] Indeed, up to 35% of asymptomatic subjects have imaging signs of tendinopathy, while up to 19% of symptomatic patients exhibit normal features at imaging.[12 14–18] The role of MRI in preoperative assessment and as a prognostic predictor is therefore, at best, controversial.

Box 6 Major pitfalls insertional Achilles tendinopathy

- Following surgery, some patients are at risk of hypertrophic scars and keloids with longitudinal medial or lateral approaches, since a longitudinal scar is more likely to retract and to irritate, because of friction.[50] Conversely, the transverse Cincinnati approach allows adequate exposure of the tissues involved, bringing also cosmetic advantage, with lower risk of retraction and irritation. As the incision is perpendicular to the course of the sural nerve, there is a slightly increased risk of lesion if the incision is extended too far laterally. However, no sural nerve injuries have reported by the authors who described this approach.[47]

Box 7 Future perspectives

- Researchers' attention should be focused on development of conservative strategies to further restrict surgical indication. Especially stem cell therapy and other regenerative strategies should be investigated to confirm their role in clinical setting. Furthermore, mini-invasive and endoscopic surgery shows promising results and deserves adequate investigation to clarify indication and techniques, in order to provide the patient with less invasive procedure and a shorter recovery time.

Overview on differential diagnoses

Heel pain is common but is not always a result of Achilles tendon disease. The Achilles tendon at its insertion on the calcaneus is surrounded by two bursae, the retrocalcaneal bursa and the superficial bursa. These are often involved in an inflammatory process, usually from overuse or direct rubbing with a rigid shoe counter. Bursitis is clinically evident for pain, tenderness, swelling and discolouration of the overlying skin.[5] Bony spurs and Haglund deformities involve the superior posterior edge of the calcaneus, where the tendon starts inserting on the bone. Spurs are common in chronic tendinopathies, arising from repetitive tissue strains or microtrauma. Conversely, the bony enlargement typical of Haglund deformity produces friction between tendon and bone, thus inducing a failed healing response of the tendon. Apart from local conditions, which affect the tendon insertion and its surrounding structures, heel pain can be also attributed to several other conditions, including os trigonum, posterior ankle impingement, talar or calcaneal fractures, flexor hallucis longus (FHL) or peroneal tendinopathies.[1] Moreover, systemic rheumatological pathologies are often a cause of insertional tendinopathies at different sites, including the insertion of the Achilles tendon.[1] Furthermore, some medications, such as fluoroquinolones, may cause tendinopathy as a side effect.[1]

MANAGEMENT OF IAT

Initial conservative treatment

Two recent reviews[2 11] reported a wide overview on the key features and conservative treatment for IAT. The Rest Immobilisation Compression and Elevation (RICE) protocol is proposed as initial treatment,[11] providing a reduction of stimuli for progression of the pathology and reduction of swelling and pain. As non-steroidal anti-inflammatory drugs (NSAIDs) act on pain modulation only, and may well interfere with healing, the prescription of these medication should be limited to those patients in whom significant inflammation is present, with the involvement of paratendinous tissues and bursae.[2]

Eccentric training

Eccentric exercises provide improvement in symptoms and function, but their effects on the pathological process are at best undefined. However, some level I studies investigated their role in comparison with several others conservative treatments. Jonsson

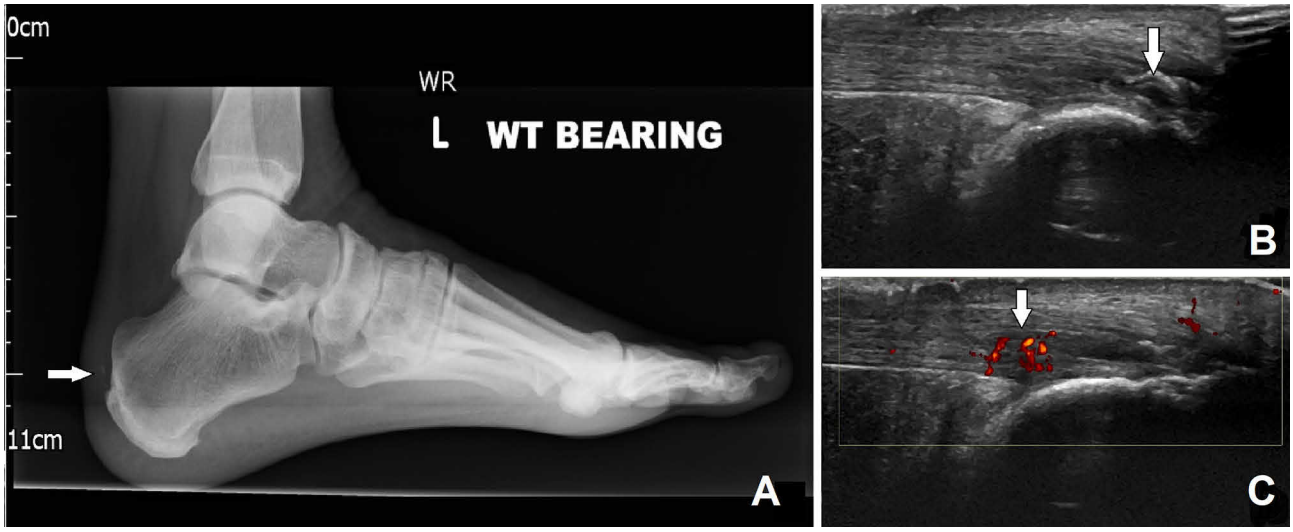

Figure 1 Imaging assessment. (A) Calcification (arrow) at the insertion of the tendon can be seen at plain radiography. (B) Evaluation of the lesion (arrow) through two-dimension ultrasound evaluation. (C) Power Doppler allows detection of areas of hypervascularisation of the tendon (arrow). WT bearing, weight bearing.

et al[33] showed a success rate of 64% in patients treated with a modified protocol of eccentric exercises, avoiding loading in dorsiflexion. Conversely, comparison of eccentric training with extracorporeal shockwave therapy (ESWT) showed the benefits of ESWT in reducing pain.[34 35] Factors other than the type of contraction (eccentric or concentric), including maximum load, speed of contraction and frequency of sessions, are to be considered to optimise the effects of this therapy. In a retrospective comparative study,[25] endoscopic surgery was superior to eccentric training and extracorporeal shock wave treatment. A recent level II randomised controlled trial investigated the use of Astym soft tissue mobilisation treatment in combination with eccentric exercises.[30] Promising results were shown with the combination of both treatment regimens compared with eccentric exercises alone. The association of eccentric exercises and ESWT has been proposed to improve outcomes.[23] However, the aforementioned evidence, though of a high level of evidence (LOE), remain isolated proofs in the scientific landscape concerning conservative treatment of IAT.

Extracorporeal shockwave therapy

Rompe *et al*[35] showed significantly improved pain following ESWT when compared with eccentric exercises,[35 36] and this was confirmed also by recent studies, showing greater reduction in VAS for pain in subjects treated with ESWT compared with eccentric exercises.[25] The presence of Haglund's deformity negatively affects the outcome of ESWT in patients with IAT.[31] Notarnicola *et al* reported the outcomes of the use of ESWT compared with High Energy Laser Therapy (CHELT), both followed by a protocol of eccentric exercises and stretching. In chronic IAT, CHELT was more effective than ESWT, although only a small cohort was studied.[37] Ultrasonographic assessment has been used to evaluate the effectiveness of ESWT on IAT.[8] Changes in tendon tissue can be observed at US, although prediction of outcome is not possible through the use of this method before treatment.[8] In clinical practice, ESWT may be prescribed in the setting of calcific IAT, with good to excellent outcomes. However, a complete tendon tear after ESWT treatment of calcific IAT has been recently reported.[38]

Paratendinous injections

Neovascularisation of the tendon in tendinopathy has been associated with functional impairment and pain. Sclerosing therapy seems to control angiogenesis and pain. Injections of the sclerosing agent polidocanol showed controversial results, with the risk of tendon rupture in high-level athletes.[39] Conversely, the

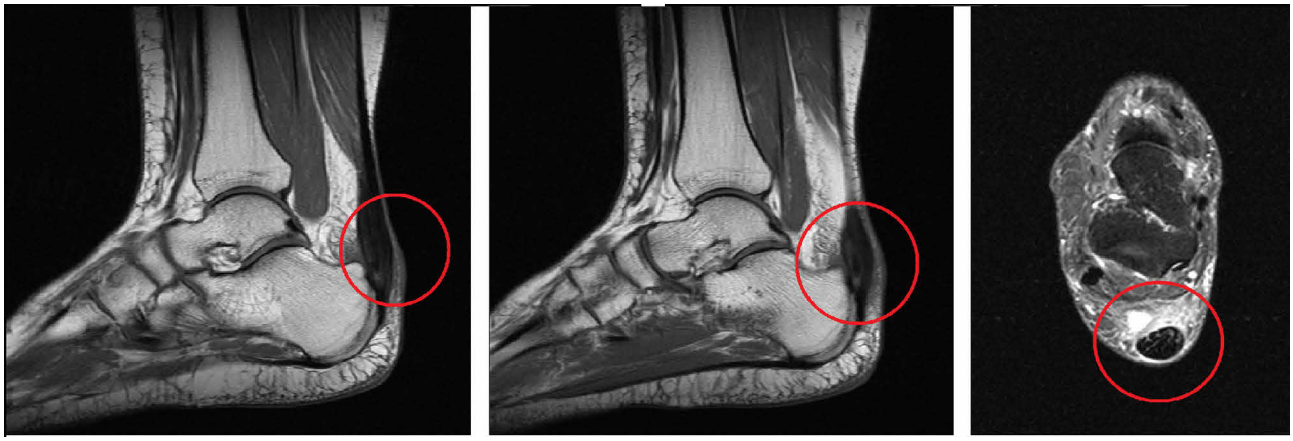

Figure 2 MRI visualisation in T2 sequences of a large insertional calcification and bursae enlargement and effusion (red circles).

use of prolotherapy with dextrose did not show increased risk of tendon rupture[40] and produced clinically relevant improvements.[41 42] Furthermore, the association of prolotherapy with eccentric exercises showed more rapid recovery from tendinopathy, in comparison with eccentric training alone.[42] Regenerative approaches, including platelet-rich plasma (PRP) injections, are probably the ultimate frontier of conservative treatment, aiming to restore original vascularisation and limiting inflammation by supplying the structure with specific growth factors. However, the literature reports variable results, and several studies assessing the outcome of PRP injections in Achilles tendinopathy did not distinguish between insertional and non-insertional tendinopathy. A series of patients treated with PRP for Achilles insertional and noninsertional tendinopathy showed 28 satisfied patients on a total of 30, with two failures of treatment in patients with insertional tendinopathy.[43] Another study[44] showed that PRP injections were more beneficial in insertional than in non-insertional tendinopathy in terms of improvement in VAS for pain and Victorian Institute of Sport Assessment for Achilles (VISA-A) score. Furthermore, a recent retrospective comparative study of ESWT and PRP injections in active patients with IAT demonstrated a comparable efficacy for both treatment, when both were associated with eccentric exercises.[19] In other unpublished studies, patients' satisfaction was 53% and 57%,[2] although the cohorts investigated were very small. Most of the cohort studies on the use of PRP in Achilles tendinopathy showed excellent outcomes with durable effect and a potential benefit in preventing degenerative lesions over time.[19] In the clinical setting, injections of either PRP or polidocanol remain a second-line intervention, usually preferring physical therapy or exercises as first choice. Several ongoing studies are testing the use of mesenchymal stem cells for the treatment of Achilles tendon lesions. Results in animals are promising, with adequate tissue regeneration and recovery of original tendon architecture.[45] However, translational evidence arising from high-level studies is missing.

Other conservative treatments

The use of night splints and orthotics has been scarcely investigated. Limiting the tension of the tendon may be beneficial in preventing rigidity. The use of heel lifts or heel wedges inside shoes may provide transient pain relief, with questionable long-term effects.[11] Although several treatments are reported for tendinopathy of the main body of the Achilles tendon,[46] no investigations have considered exclusively IAT.

Open surgery

Debridement of the insertional portion of the Achilles tendon is the classical surgical treatment for those patients who did not respond to conservative therapy. Open approaches include midline longitudinal incision, lateral longitudinal incision,[26] the Cincinnati transverse incision[47] and curvilinear incision.[48 49] Furthermore, the senior author routinely uses a medial longitudinal approach in patients who present with isolated pain over the medial portion of the insertion of the Achilles tendon on the calcaneus.[1] A longitudinal approach over the centre of the Achilles tendon allows adequate exposure of the tendon, its insertion and the surrounding tissues, with minimal vascular disruption and low risk of injury for the sural nerve.[50] However, it lies directly in the path of the heel tab of sport shoes, and the scar can easily be irritated by it. Thus, its use in our practice is limited. The Cincinnati transverse incision has become the preferred approach in last few years, providing minimal postoperative discomfort for the patient. This approach allows adequate exposure of the distal portion of the Achilles tendon and its insertion, debridement of the pathological tissue and of the subcutaneous bursa. Further exposure of the lateral and medial margins of the tendon allows also to debride the retrocalcaneal bursa and access the retrocalcaneal space without detaching the tendon insertion.[51] Bony prominence in that area can be addressed through this approach, without detaching or splitting the tendon (figures 3 and 4).

A medial or lateral approach may be used to expose only the part of the tendon involved. The lateral approach is associated to better outcomes,[52] since the Achilles tendon extends laterally from posterior to anterior less than on the medial aspect. Therefore, elevating and detaching the lateral insertion should minimise the risk of postoperative avulsion.[52] If needed, up to 50% of the insertion can safely be detached from the calcaneus.[53] Furthermore, superior-to-inferior resection is the best approach.[53] The senior author's preferred choice is to reattach the tendon insertion with suture anchors when one-third or more of the insertion is detached. The number of anchors used is dictated by the percentage of disinserted tendon. Between 33% and 50%, two anchors are sufficient; between 50% and 75%, three anchors are used; if more than 75% of the tendon is disinserted, four anchors are used; and five anchors if the tendon is totally disinserted.[1] Studies concerning reattachment of the tendon showed improved American Orthopaedic Foot and Ankle Society (AOFAS) score for those patients treated by double row repair, when compared with single row repair.[21 26 54] Although satisfaction of the patients after surgery is relatively high (87%, with postoperative AOFAS scores ranging from 81 to 96), the complication rate ranges from 6% to 30%, with major complication including sural nerve lesion and neuritis, tendon avulsion, recurrence of pain and generic surgical site comorbidities.[20 22] Despite the high rates observed, satisfaction of patients is broadly comparable among the various studies.[55] A systematic review in 2012 showed that rates of minor and major complications varied accordingly with the techniques used and with the presence or not of calcifications. Medial curvilinear or medial longitudinal incision approaches were considered the safest, while lateral approaches were the most likely to yield minor complications.[55] The average recovery time[56] ranges from 12[57] to 31 weeks,[1] with return to sport taking place at 38 weeks from the operation in some patients.[51]

Tendon augmentation

Transfer of the tendon of the FHL is the main technique used in patients with severe extensive degeneration of the tendon, when more than 50% of the original Achilles tendon is resected.[57 58] This is frequent in patients aged over 50 years. However, a recent randomised trial showed no difference between two groups of patients who underwent decompression and debridement, with or without FHL tendon transfer.[20] A relevant complication of this surgery is the accidental resection of the medial or lateral plantar nerve.[59] Autologous tendon transfer procedures also include ipsilateral hamstring tendons augmentation.[60] This technique was proposed for large chronic tears of the Achilles tendon and resulted in excellent outcomes, with minimal invasiveness.[60] Recently, gastrocnemius lengthening has been proposed in the management of chronic IAT. The techniques proposed involve isolated release of the gastrocnemius, through either an endoscopic or an open approach: once the aponeurosis is visualised, it is sectioned from the soleus muscle, from lateral to medial. Attention must be paid to avoid transection of the sural nerve,

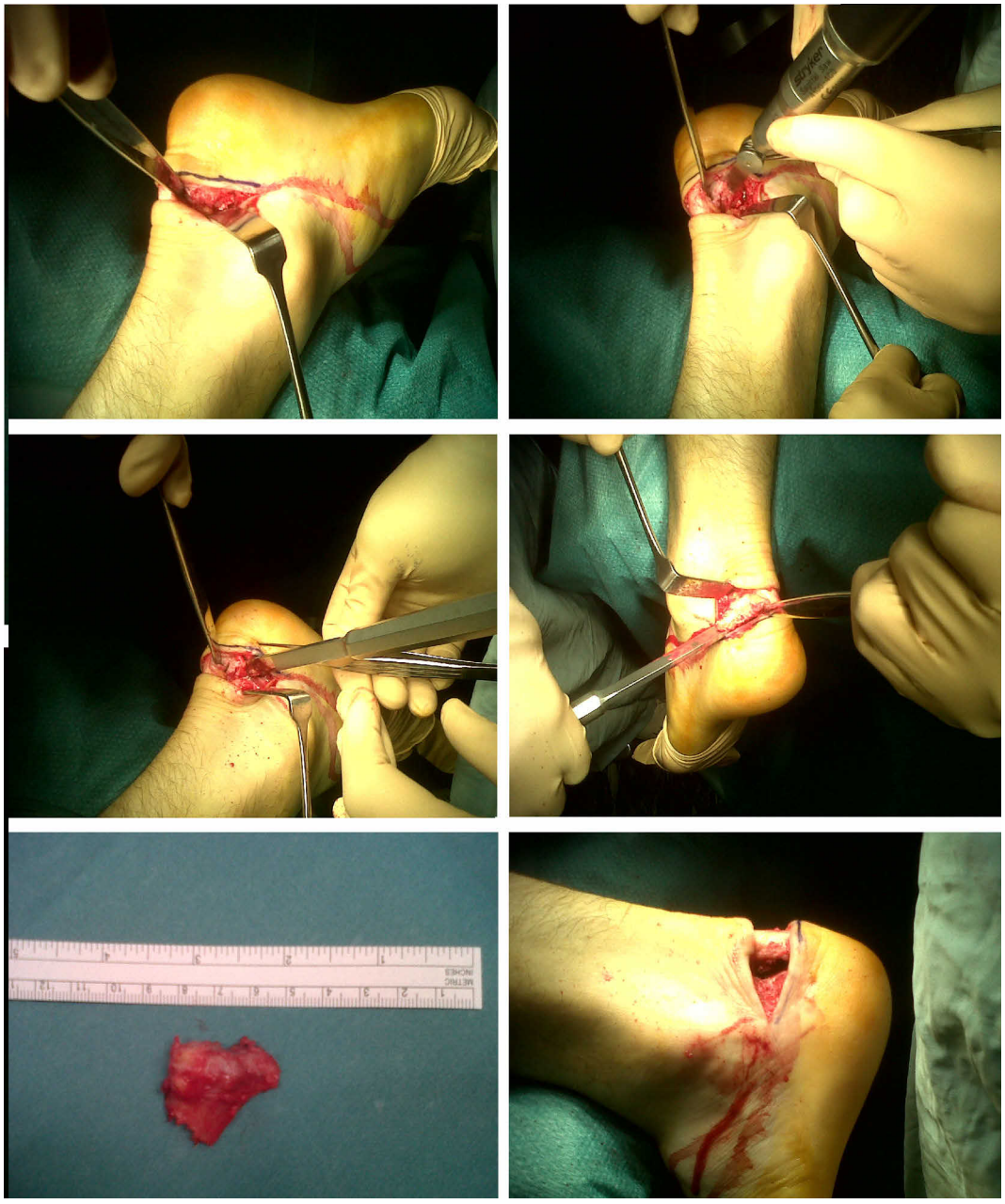

Figure 3 The sequence shows a bone spur removal procedure through a Cincinnati transverse incision.

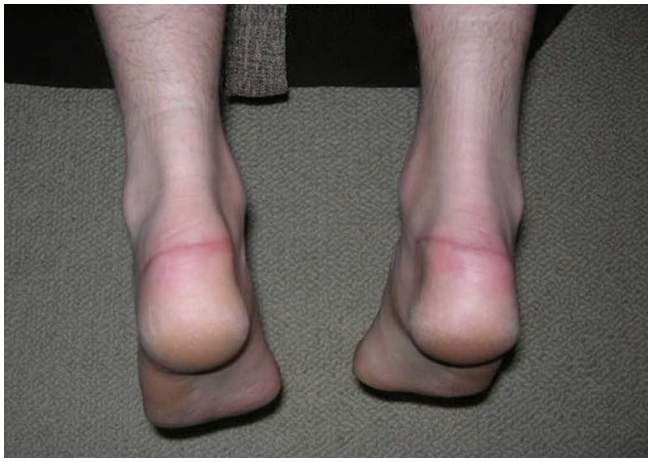

Figure 4 Long-term appearance of Cincinnati transverse incision.

and the release must be always performed under direct visualisation. A single surgeon series on 11 patients showed promising results in terms of AOFAS score and pain, achieving a 91% satisfaction rate.[24] Another series of nine patients treated with open approach presented good outcomes, with a superiority of results for those with IAT, compared with those with non-insertional pathology.[61]

Endoscopic and minimally invasive surgery

To improve on less invasive approaches to the ankle, tendon sheath endoscopy (subsequently renamed 'tendoscopy') was developed for diagnosis and treatment of pathologies of the tendons around the ankle. In 1997, van Dijk and colleagues[62] developed tendoscopy of the peroneal tendon, tibialis posterior and Achilles tendons. Tendoscopy for Achilles tendon was thereafter used to undertake minimally invasive management of these conditions. Only few investigations have been published

concerning this treatment, and the LOE is low. The literature reports several series dealing with midportion tendinopathy and tears,[63 64] but insufficient evidence is available to support the use of tendoscopy for insertional tendinopathy. A single comparative study[65] reported outcomes of open versus percutaneous approach for debridement and decompression, showing lower complication rate and improved AOFAS scores for those undergoing percutaneous intervention. Although significantly less invasive and with lower surgical site morbidity, limitations of the percutaneous approach include the technical difficulty to debride intratendinous calcifications. Overall satisfaction of the patients treated by endoscopic calcaneoplasty was reported as good or excellent in 87%–95% of patients.[66–68]

Postoperative management

Day surgery case can be performed either for open and endoscopic approaches, having offered to the patient comprehensive information about postoperative care. The ankle is immobilised in a below-knee synthetic cast with the foot plantigrade. Weight bearing is allowed as tolerated, and two crutches are used. The patient is usually encouraged to progressively increase weight bearing. After 2 weeks, the cast is removed. Before cast removal, isometric contractions of the gastrosoleus complex and other calf muscles are advised, starting supervised gentle mobilisation of the ankle after cast removal. Complete return to sport activities is commonly allowed at 6–9 months after surgery.[1] As early return to activity may be harmful, it is advisable to provide coaches and physiotherapist with appropriate education concerning progressive and cautious return to activities.[51]

GEOGRAPHICAL DIFFERENCES

Europe

Initial treatment in Europe generally starts with conservative RICE approach. Anti-inflammatory treatment with NSAIDs is advocated only when a bursitis is present. Heel wedges are advised to provide the ankle with slight plantarflexion, thus avoiding tension stress to the Achilles tendon. Rehabilitation usually includes eccentric exercises, and ESWT is associated when calcific tendinopathy or retrocalcaneal exostosis are present. Success can be achieved in up to 70% of patients,[72 73] but it can be unpredictable, and in a few patients, regenerative strategies are used. PRP is often administered in refractory cases, with a course of three peritendinous injections, each 1 week apart. When also regenerative strategies fail, surgical management is needed, and surgical debridement is performed.[51] Tendon detachment and reinsertion follows what described in the open surgical technique section.

North America

Non-surgical treatment in North America can involve a period of immobilisation in a removable cast or boot, with and without heel wedges.[47 58 74] Introduction of treatment with radial extracorporeal shock wave therapy (rESWT) is often reserved after failure of 6 months of conservative treatment, although the latter may result in a 60%–75% overall success rate.[31 35 75 76] Earlier implementation of rESWT may improve outcomes for non-surgical treatment of IAT, similar to what has been shown for plantar fasciopathy, although further studies are needed.[77]

Surgical treatment typically involves anchors loaded with braided non-absorbable sutures, often with an embedded polyethylene core. This particular suture material with a polyethylene core has been associated with suture granulomas and wound complications.[49 78 79] Other non-evidence-based procedures, such as percutaneous ultrasonic tenotomy, have become somewhat trendy, being touted as 'less-invasive'. However, their outcomes are unproven, and complications are being documented similar to 'more invasive', that is, traditional surgery.[80] A comparison of similar techniques would reveal whether there are any significant differences. Postoperatively, anticoagulation during the non-weightbearing phase is typically not prescribed unless there exist risk factors such as obesity, previous venous thromboembolism or a clotting disorder.[81–83]

South America

Non-surgical treatment for IAT in South America generally includes physiotherapy and eccentric exercises for a minimum of 6 weeks and up to 3 months, depending on symptoms. ESWT has become part of the standard treatment offered to non-responsive patients, and clinical success is reported in about 60% of patients. Given highly demanding patients, frequently surgery is offered before the classic 6 months' timeframe if conservative treatment has failed.

The mainstay of surgical treatment has been open surgery with debridement of the macroscopically diseased enthesis, in addition to removing the pericalcaneal bursae and the bony deformity of the posterosuperior corner of the calcaneus. In the last few years, Achilles tendoscopy has been applied in patients where tendinopathy is mild, and mainly bursitis and a posterosuperior calcaneal prominence are found. In these patients, the main surgical focus has been on removing the potential impingement between the calcaneus and the distal portion of the Achilles tendon.[84] No long-term follow-up is available for these treatment, and therefore no definite conclusion or recommendation can be given. For more severe cases, where after debridement less than 25% of the enthesis is left intact, a complete detachment and reconstruction is performed.[85] Satisfactory results can be produced, with no apparent deleterious effect on the biomechanics of the Achilles tendon.[86] Most commonly, a double row of anchors is used to reinsert the tendon onto the calcaneus. In severe tendinopathy with extensive compromise of the enthesis, in which commonly Achilles detachment and reinsertion would be indicated, we do not routinely recommend or perform FHL transfer, as we believe that the main pathology lies in the tendon and not in the musculotendinous unit, and therefore, it is not appealing to sacrifice a healthy musculotendinous unit. In these patients, a free tendon autograft (semitendinosus or gracilis) or an allograft would seem preferable to replace diseased tendon if there is a gap after the debridement. Postoperative treatment includes immediate weight bearing as tolerated, in a cam walker, using two crutches for 2 weeks, and then progressive full weight bearing during the following 4 weeks. Using a double row of anchors in these reinsertion cases has been rewarding, allowing faster rehabilitation and shorter time to return to daily activities.

Asia-Pacific region

In Asia, major developments of endoscopic surgery have been reported. Since endoscopic surgery appears to produce a lower complication rate compared with open surgery, it constitutes a significant growing technique in surgery of the Achilles tendon, with functional results comparable with that of open approaches.[87] The group of Lui *et al* published several studies concerning endoscopic surgery for Achilles tendon tendinopathy. Supine Achilles tendoscopy is performed accessing the ventral aspect of the tendon sheath and shaving

of the adhesions and neovascularisation on the ventral side. The retrocalcaneal bursa is visualised through the posteromedial portal and dissected through the posterolateral portal. As only the lateral side of the calcaneal tubercle is seen in this way, after dissecting it through an arthroscopic acromioniser, a switch of the portal can be performed, and the medial part of the tubercle is visualised.[88] When calcaneoplasty is needed, endoscopic detachment of the Achilles tendon is required, and endoscopic reinsertion may be perfomed. The patient is prone, not supine, as for the ventral tendoscopy. Two suture anchors are inserted through the medial and lateral portals, and three to four Krackow sutures are knotted for each side.[89–91]

DISCUSSION

Insertional tendinopathy of the Achilles tendon is markedly different from midportion tendinopathy.[1] This is not surprisingly given to the different histological structure of the body of the tendon (parallel, ordered collagen fibres) and the enthesis (tendon–bone interface), with marked differences in vascularisation density of these two areas. Hence, the diagnosis, but even more the treatment, should follow different lines, both for conservative and surgical management. The clinical features of IAT are definite, and the symptoms reported are fairly typical. The diagnosis of IAT is clinical, and only when a different diagnosis is suspected is advanced imaging advised. Radiography is indicated to define the presence of Haglund's deformity and bone spurs, including retrocalcaneal exostosis. Ultrasound assessment is indicated when there is clinical suspicion of inflammatory pathology of the bursae or when a tendon lesion is palpated. Similarly, MRI investigation can be useful to assess the paratendinous soft tissues and exclude other pathologies. Since peritendinous soft tissue inflammation requires special considerations during conservative management, US evaluation is actually routinely performed. Conservative management is beneficial in the initial stages of the condition and may lead to success in 60%–80% of patients. Surgery should be considered when conservative treatment fails. Initial strategies for the management of IAT include the RICE approach and pain control, and physical therapy should be initiated. Level I studies have been performed on eccentric exercise and ESWT, showing promising results. Furthermore, regenerative techniques, including prolotherapy and PRP injections, are used to provide tissue regeneration in chronic tendinopathy. The main issue in this approach lies is the exact definition of the pathophysiological features of IAT, the molecular mediators and cells involved. Science concerning PRP is improving, and PRP subtypes with increased concentration in leukocytes or in specific growth factors may be the key for further developments of this therapy. Since neovascularisation of the tendon seems to be associated with impairment and pain, control of vascular proliferation by subtracting or adding specific growth factors to PRP is at present a most important scientific challenge.[92] At present, no modality or conservative intervention can guarantee the resolution of symptoms of IAT. Geographical differences have been assessed, since in USA immobilisation of the ankle is advocated as initial treatment, while mobilisation and eccentric exercise are routinely prescribed in Europe and South America. Furthermore, in North America, several strategies are being proposed to improve outcomes of conservative management. These treatments include rESWT and percutaneous US tenotomy. Regenerative strategies have been recently investigated to provide biological support to the degenerative tendon tissue and try to soothe the inflammatory process. The sclerosing agent polidocanol has been used mainly for the management of tendinopathy of the main body of the Achilles tendon, and its use for IAT is controversial.[39] The use of prolotherapy with dextrose did not result in increased risk of tendon rupture and produces clinical improvement.[42] Furthermore, the association of prolotherapy with eccentric exercises on the flat resulted in more rapid recovery from IAT in comparison with eccentric training alone. Recently, attention has focused on PRP injections, but the level I studies do not show definite positive effects. Surgery is advocated in patients in whom refractory or chronic IAT is diagnosed. Usually, a 6-month time-lapse is given for the conservative treatment to improve clinical condition, and surgery is proposed if no benefit is observed. However, some authors suggest to perform surgery also before 6 months, especially in high-demand athletes in the absence of improvement with conservative treatment. The different surgical approaches should be chosen on a patient-by-patient basis, as different tendinopathy patterns and different associated bony and soft tissue conditions may influence preoperative planning. Imaging evaluation is also useful in this context, to plan the best surgical approach and to define structures to debride and lesions that deserve repair. Originally developed in Europe, endoscopic interventions are commonly employed in the Asia-Pacific region and are indicated where a minimal debridement of the tendon and/or bone is needed, in the absence of large calcifications and spurs. Some authors advocate a minimally invasive approach also for retrocalcaneal exostosis and Haglund deformity excisionthrough posterior Achilles tendoscopy.[88] Furthermore, augmentation with local tendons should be considered in patients in whom a sizeable portion of the Achilles tendon is degenerated and must be excised, though, at this point, no high LOE studies exist to indicate who may benefit from this.[2] The role of bony pathology should be accurately investigated, as it is unclear whether the presence of spurs may affect outcomes of surgery.[55] Future studies on IAT should assess outcomes using the VISA-A score, documenting also activity level, and return to activity time frames.[93]

CONCLUSION AND FUTURE PERSPECTIVE

Given the high prevalence of IAT, an ongoing evaluation of this pathology is encouraged. The development of new and effective conservative treatment should be considered of paramount importance, as well as the identification of best surgical techniques and improvement of technologies. Special attention should be paid to the percutaneous surgery and tendoscopy, since mini-invasive strategies are being growing in interest in all surgical fields. Furthermore, regenerative medicine, through the use of growth factors and stem cells, is a promising modality for conservative management of tendinopathy and small tears. However, clinical experimentation is needed to draw final conclusions.

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